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1271389

DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN ELECTROMAGNETIC RELAYS

(71) We, WESTINGHOUSE AIR BRAKE COMPANY a Corporation organised and existing under the Laws of Pennsylvania, United States of America, of Pittsburgh, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electromagnetic relays and particularly to multiple contact electromagnetic relays.

According to the invention there is provided an electromagnetic relay having means to suspend an armature from a resilient portion of the contact set across a gap in the magnetic circuit of the relay formed by the pole pieces for movement towards and away from the gap, and a stop member on the means to suspend the armature to limit the movement away from the gap.

The armature may ba gravity biased. The armature may be biased by the resilient portion which may be the springs of the movable contacts of a multiple contact set of the relay. The means to suspend the armature may be an operating ladder for one or more contact sets. The pole pieces which define the gap may be L-shaped and extend from opposite ends of a core of a coil of the relay towards each other. The contact set or sets may be supported on one of the pole pieces and means on the contact set may co-operate with means on the supporting pole piece to properly position said set.

Embodiments of the invention will now be described with reference to accompanying drawings in which:—

Figure 1 is a side elevational view of an electromagnetic relay embodying the present invention with a portion of the contact assembly broken away.

Figure 2 is a cut-away perspective view of the movable armature assembly employed in the relay of Figure 1,

Figure 3 is a top view of the relay of Figure 1 with portions broken away.

[*Price 25p*]

Figure 4 is a front elevational view of the relay of Figure 1 with a portion of one of the electromagnetic pole pieces broken away for showing various details of the armature assembly.

Figure 5 is a rear elevational view of the relay of Figure 1.

Referring now to the drawings and more particularly to Figure 1, it will be noted that the electromagnetic relay generally characterized by numeral 1 basically includes an electromagnetic assembly 2, a multiple type of moulded contact assembly 3, and a moulded movable armature assembly 4.

As shown, the electromagnetic assembly 2 includes an energisable coil or winding 8 which is carried by a suitable insulating spool 9 having a circular end flange 9a and a square-edged end flange 9b. A cylindrical magnetic core 10 extends through the centre of spool 9 and has its rear end securely fastened, such as by welding, to the laterally extending portion or leg of a first L-shaped pole piece member 12 which is preferably of rectangular cross section. As shown, a spring washer 14 encircles the core member 10 and is disposed between the pole piece member 12 and the flange portion 9a of the insulating spool 9. The spring washer 14 reduces the tolerance requirements of the various parts and also prevents undue compressive forces to be exerted on the insulating spool and coil yet provides a tight fit by taking up what end play remains after assembly. Preferably, the front end of the core 10 has a reduced threaded portion which is adapted to pass through a suitable circular opening in a laterally extending portion or leg of a second L-shaped pole piece member 13 which is also of rectangular cross section. As shown in Figures 1, 3 and 4, a relay handle member 16 is disposed adjacent the pole piece 13 and also encircles the threaded portions of the reduced core portion. The handle 16 is provided with a diagonally extending hand gripping portion 16a, and an inwardly extending flange portion or tab 16b, the purpose of which will be described presently.

A cap nut 17 is screwed onto the threaded portion of the core for retaining the handle 16 and the L-shaped pole piece 13 in place and for urging the flange 9a of the spool 9 against the spring washer 14 thereby firmly holding the parts together. As shown in dotted lines in Figure 4, the square edge of flange portion 9b cooperates with upper flat surface of the inwardly extending tab 16b for preventing rotational movement of the coil and spool. While the laterally extending legs of each of the L-shaped pole pieces are rigidly secured to the respective ends of the core 10 and extend in the same direction, the other legs of the L-shaped pole pieces extend parallel to the longitudinal axis of the core 10. These horizontally extending legs of the pole pieces 12 and 13 extend toward each other to within a short distance of each other for defining a suitable magnetic air gap 18. As shown, the horizontally extending leg or portion of pole piece member 12 is employed for supporting the remaining structure of the relay proper.

The moulded contact assembly 3 includes a plurality of contact sets or stacks each comprising a moulded block of suitable insulating material and a plurality of fixed and movable spring contacts which are disposed in superimposed cooperative association with each other. While three contact sets have been illustrated for the sake of convenience, it will be understood that a greater or lesser number of sets may be employed. Each of the contact sets shown includes a block of suitable insulating material 19 in which are moulded two combinations of dependent fixed and movable contact springs 22, 23 and 24. It will also be understood that alternative combinations of dependent and/or independent contact sets may be used. The insulating blocks 19 are suitably disposed in side-by-side relationship on the upper surface of the horizontal leg of the pole piece 12. It will be noted that each side of the blocks is provided with a semi-circular groove or cylindrical recess 20 extending the length thereof, the purpose of which will be described hereinafter.

To facilitate the positioning of the insulating blocks in side-by-side relationship, it is preferable to provide a cylindrical projection on the bottom of each of the insulating blocks 19, one of which is shown at 19a in Figure 1. As shown, the projections are adapted to fit snugly into suitable holes provided in the horizontal leg of the pole piece member 12. Further, it will be noted that each block 19 is also provided with notches 21 on each of the upper respective corners thereof, the purpose of which will be described later. As shown, the fixed and movable contact springs are provided with rearwardly extending terminal portions 22a, 23a and 24a, respectively, which are adapted for electrical attachment to the various external circuits. The relay may be hand wired to the external circuits, such as, by soldering the ends of the lead wires to the apertures, shown in Figure 3 provided in the respective terminal portions. Alternatively, the relay may be employed for plug-in installation with a suitable mounting base, as will be described hereinafter. It will be noted that the forward extending portions of the fixed contact springs 22 and 23, namely, the front and back contacts are preferably bifurcated and that each bifurcation is provided with a separate contact point or tip 22b and 23b, respectively. It will be appreciated that with the free ends having separate or dual contact points the electrical contact characteristics are improved. A dual contact tip 24b is also provided on each of the movable contact springs 24 for cooperative association with the respective contact tips of the front and back contacts. It will be noted that the movable contact springs are formed with an offset portion 25 and a punched tab portion 26 at their free ends, the purposes of which will be described in greater detail hereinafter.

As shown, the horizontal extending leg of the L-shaped pole piece member 12 also carries a fixed ladder 30 which maintains the fixed contact springs in their normal rest position. The fixed ladder 30 is preferably constructed of a suitable insulating material, such as clear polycarbonate, and includes a plurality of laterally extending projecting shoulders or cross pieces 31 which cooperate with the various contact springs. The fixed ladder 30 is provided with a circular projection 32a on the top surface thereof, the purpose of which will be described hereinafter. The fixed ladder 30 is also provided with a pair of circular projections 32b on the bottom thereof, one of which is illustrated in Figure 1, which are adapted to fit in suitable holes in the longitudinal leg of the L-shaped pole piece member 12. Further, as shown in Figure 4, the fixed ladder 30 includes a rectangular opening 33 through which the elongated contact springs can pass for actuation purposes.

In the presently described arrangement, the fixed ladder and particularly the projecting shoulders or cross pieces 31 cooperate with contact springs to permit an open transfer function, namely, a break-before-make switching operation of the contacts. However, the projecting shoulder or cross pieces 31 of the fixed ladder may be arranged to provide an overlap transfer function, namely, a make-before-break switching operation.

The contact assembly also includes a stack plate 34 having a forward extending portion 35 and a rearward extending portion 36. The intermediate portion of the stack plate 34 is provided with a pair of downwardly pro-

jecting tabs 37 on each side thereof which cooperatively engage the two outer corner notches 21 of each of the outer insulating blocks 19. It will be noted that the forward extending portion 35 includes a suitable hole 35a for accommodating the cylindrical projection 32a formed on the top of the fixed ladder 30. The insulating contact blocks 19 and the fixed ladder are securely held in their respective positions by the stack plate 34 and are rigidly clamped to the horizontal leg of the L-shaped pole piece 12 by means of screws 39 and lock washers 40. As shown in Figure 3, the two elongated semi-circular grooves 20 of the intermediate insulating block 19 and the inner elongated semi-circular grooves 20 of the two outer insulating blocks 19 form a cylindrical opening for accommodating the passage of screws 39 which are screwed into the horizontal leg of the L-shaped pole piece 12. Further, it will be noted that the outer elongated semi-circular grooves 20 of the two outer insulating blocks 19 also provide a convenient method of holding the two coil leads 42 of the energisable coil 8. A length of cambric or other insulating tubing is fixedly attached, such as by gluing, to semi-cylindrical surfaces of each of the grooves 20 of the outer insulating blocks 19 so that the coil leads 43 may be passed therethrough. This not only results in an orderly configuration but also prevents the coil leads from interfering with the normal operation of the relay, such as by restricting contact movement. The free end of each of the coil leads is provided with suitable connecting terminal 44, such as a solderless female tab socket, which is crimped onto the end thereof. The solderless terminals are, in turn, push-fit to the terminal portions 45 which also are moulded in the top of the insulating blocks 19. The terminal portions 45 in turn may be connected to a suitable source of power for energising the coil 8.

The movable armature assembly 4 comprises an operating ladder or driver 50 of an insulating material, an intermediate stop member 52 and an armature member 53 which is constructed of suitable magnetic material and has a rectangular cross section. Referring now to Figure 2, a more detailed showing and a better understanding of the movable armature assembly can be obtained. The assembly is preferably of an integrally moulded construction with the stop member 52 disposed intermediate the ends of the operating ladder 50 and the magnetic armature member 53 disposed at the lower end of the operating ladder 50. The assembly is suspended from the movable contacts 24 which have their free end passing through suitable slots or rectangular openings 51 appropriately located in the operating ladder 50. As shown in Figure 1, the rear surface of the operating ladder 50 is disposed against the offset portions 25 of the movable contacts 24 while the front surface of the operating ladder 50 is engaged by the punch tabs 26 which are shown bent upwardly for rigidly holding and detachably fastening the movable armature assembly 4 thereto. The armature member 53 has each side partially encompassed by enlarged moulded shoulders 54 which are formed on the lower end of the operating ladder 50. Accordingly, the entire assembly 4 is held in guided alignment by the free ends of the movable contact springs 24 and the stop member is shown disposed adjacent the upper surface of the pole piece members 12 and 13 while the armature member 53 is disposed adjacent the under surface of the horizontal legs of the pole piece members 12 and 13. Therefore, with the relay deenergised the stop member 52 rests upon the upper surface of the pole piece members 12 and 13 thereby limiting the amount of downward movement and establishing the required magnetic air gap between each end of the armature member 53 and the under surfaces of the pole piece members 12 and 13. Preferably, a layer of non magnetic or insulating material such as a strip of self-adhesive insulating tape or a strip of non-ferrous metal 55 is attached to the upper surface of each end of the armature member 53 for providing a residual air gap between the armature and the pole piece members. This ensures that the armature member will not directly engage the pole piece members so that the residual magnetism will not cause the armature to stick to the pole pieces or fail to immediately release upon interruption of the coil current. In practice, the operating ladder and the integral stop member are preferably moulded from suitable insulating material, such as clear polycarbonate, to allow readily visual inspection of the contact points. With the stop member constructed of suitable insulating material a "soft" effect is realised so that contact bounce is minimised due to the deadening characteristics of the insulating material.

As previously mentioned, the presently described relay may be hand-wired or employed in a plug-in installation. For plug-in installations, a suitable moulded mounting base 56, such as shown in chain lines in Figure 1, is utilised in conjunction with the relay 1. A plurality of terminal connectors 56a only one of which is illustrated in Figure 1, cooperate with the terminal portions 22a, 23a and 24a of the front, back and movable contacts 22, 23 and 24, respectively. In order to facilitate the insertion and plug-in connection of the relay with the mounting base 56, a pair of horizontal guides or indexing pins 57 one of which is shown in Figure 1, communicate with suitable aper-

tures 58 drilled into the lateral extending leg of pole piece member 12. It will be noted that the mounting base 56 is also provided with a shoulder 59 and a notch 60 at its upper extremity which cooperate with the rearward extending hook-like portion 36 of the stack plate 34. As shown in Figure 1, the rearward extending portion 36 of the stack plate 34 is resilient biassed downwardly so that the hook portion snaps into the notch 60 for securely holding and locking the mounting base 56 in relation to the relay. Preferably, the mounting base may be fastened by means of a conventional U-shaped mounting bracket which encompasses an elongated mounting bar having a rectangular cross section in a rack-type installation. As shown, the insulating mounting base 56 is provided with suitable bores 61 which are countersunk at the forward end for accommodating the screws and nuts common to the U-shaped bracket.

The relay may be readily detached and disconnected from the mounting base 56 by grasping handle 16 and applying a twisting pulling motion to unsnap the hook-like portion 36 from the notch 60.

In hand-wiring installations, it will be noted that the U-shaped mounting bracket may be directly fastened by appropriate screws threadely engaging threaded apertures 62 (Fig. 5) provided in the lateral arm of the pole piece member 12. Accordingly, the relay is adapted for either plug-in or hand-wiring installations.

As previously mentioned, in its deenergised condition, the relay assumes a position as illustrated in Figure 1 wherein the suspended armature 53 is in its released position. In this condition, the stop member 52 limits the amount of downward movement so that excessive stresses are not exerted on the contact springs. It will be noted htat the stationary contact springs are permitted to move away from the shoulders 31 of the fixed ladder 30 during closure of the contact points so that a wiping action occurs, and therefore, the contact points are self-cleaning. With the relay denergised and its magnetic armature released, the back contacts 23a of the various sets are engaged by the movable contacts 24b while the front contacts 22b of the various contact sets are disengaged. Under this condition, the external circuits common to the back and movable contacts are completed while the external circuits common to the front and heel contacts are not completed.

When the relay becomes energised by appropriately connecting a source of power to the external circuit common to the coil connecting terminals 45, the magnetic flux created by current flowing through coil 8 causes the armature member 53 to be attracted upwardly toward the under surfaces of the pole piece members 12 and 13. The upward movement of the armature causes the operating ladder 50 to move therewith so that the movable spring contacts 24 are also displaced upwardly, as viewed in Figure 1. The upward movement of this movable spring contact 24 causes the contacts 24b to initially break contact with the back contacts 23b and then to make contact with the front contacts 22b thereby interrupting the external circuits common to spring contacts 23 and 24 and establishing the external circuits common to the spring contacts 22 and 24. As previously mentioned, the strips of non-magnetic material 55 provided on the upper surface of armature member 53 prevents direct or intimate contact with the pole piece portions of the pole piece members 12 and 13 so that residual magnetism will not cause the armature 53 to stick upon the deenergisation of the coil winding 8. When the current to terminals 45 is interrupted, the coil 8 becomes deenergised and the flux in the magnetic circuit rapidly decays so that the armature is immediately permitted to be released. The weight of the movable armature assembly is usually sufficient to cause the assembly to move rapidly downward to a position where the stop member 52 again engages the upper surfaces of the pole piece members 12 and 13. However, where faster release of the relay is desired the movable contact springs may be biassed or tensioned to urge the movable armature assembly downwardly thereby assisting gravitational force. Accordingly, the relay again assumes its released position as shown in Figure 1.

It will be appreciated that by employing a suspended type of armature assembly frictional wear and surface drag is eliminated between the moving and stationary parts. A suspended type armature also eliminates additional parts, such as, biassing springs, pivotal shafts or rods as well as fulcrum edges which are necessary elements in conventional pivoted armature types of relays.

The movable contacts not only perform their switching transferring function but also operate to suspend and guide the armature with respect to the stationary structure. Accordingly, the multiple function of the movable contact springs eliminates the above-mentioned elements and results in a more economical relay construction since material and production costs for such elements have been completely omitted.

Further, the moulded contact assembly herein described permits great versatility of the contact arrangement without the need of a plurality of insulating washers disposed between the contacts and also eliminates the tedious task of assemblying the contact stacks as heretofore required. An entire contact set, namely, each of the insulating block and spring contacts, may be readily replaced with the minimum of time during maintenance and repair. Further, as previously mentioned

various types of moulded contact combinations, such as, single-pole-single-throw or single-pole-double-throw and make-before-break or break-before-make, etc., may be readily conjointed during initial assembly.

In addition, the stack plate not only retains the contact stacks and the fixed ladder in proper relationship with the relay proper but also is employed for holding and locking the relay to the mounting base when the relay is employed in a plug-in installation.

Likewise, the moulded contact blocks 19 of the contact assembly not only function to rigidly maintain the contact springs in proper relationship to each other but also perform the dual function of accommodating the fastening screws 39 and of retaining the insulating tubes 42 for holding the coil lead 43 in nonobstructing relationship with the other parts of the relay.

WHAT WE CLAIM IS:—

1. An electromagnetic relay having means to suspend an armature from a resilient portion of the contact set across a gap in the magnetic circuit of the relay formed by the pole pieces for movement towards and away from the gap, and a stop member on the means to suspend the armature to limit the movement away from the gap.

2. A relay as claimed in Claim 1 in which the armature is gravity biased.

3. A relay as claimed in Claim 1 or Claim 2 in which the armature is biased by the resilient portion.

4. A relay as claimed in any one of the preceding Claims in which the resilient portion is a movable contact spring in a multiple contact set of the relay.

5. A relay as claimed in any one of the preceding claims in which the means to suspend the armature is an operating ladder through which operating ladder the armature is operatively connected to one or more contact sets.

6. A relay as claimed in any one of the preceding claims in which the stop member is on the other side of the gap from the armature.

7. A relay as claimed in any one of the preceding claims in which the pole pieces which define the gap are L-shaped and extend from opposite ends of a core of a coil of the relay towards each other.

8. A relay as claimed in any one of the preceding claims in which the armature, the means to suspend the armature and the stop member are formed by a moulded assembly.

9. A relay as claimed in any one of the preceding Claims in which one of said pole pieces supports one or more contact sets for operation by said armature.

10. A relay as claimed in Claim 9 in which means on the contact set cooperates with means on the supporting pole piece to properly position said set.

11. A relay as claimed in any one of the preceding Claims in which the armature is isolated from contact with said pole pieces by a layer of non-magnetic material.

12. A relay comprising a magnetic core, an energisable coil surrounding said core, a pair of pole pieces, each pole piece secured to the respective ends of said core and extending upwardly and inwardly to within a given distance of each other, a contact assembly having a plurality of elongated stationary and movable contact springs moulded in blocks of insulating material, a fixed ladder disposed adjacent the free ends of said contact springs, a stack plate having an intermediate portion engaging said blocks of insulating material and having a forward extending portion engaging said fixed ladder for holding said blocks and said fixed ladder on one of said pole pieces, a moulded assembly having an operating ladder suspended from the free ends of said movable contact springs, having an armature secured to the lower end of said operating ladder and disposed below said pole pieces, and having a stop member secured intermediate said movable ladder and disposed above said pole pieces.

13. An electromagnetic relay substantially as herein described with reference to the accompanying drawings.

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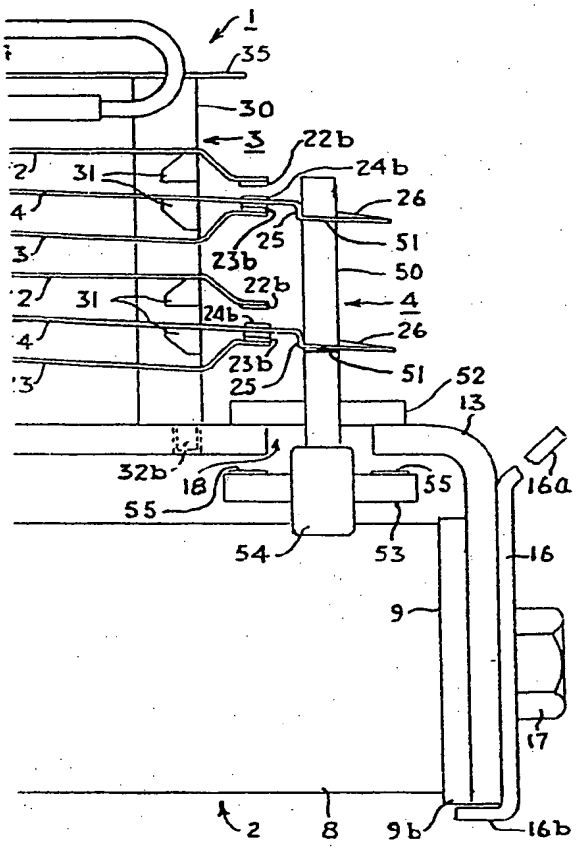


Fig. 1.

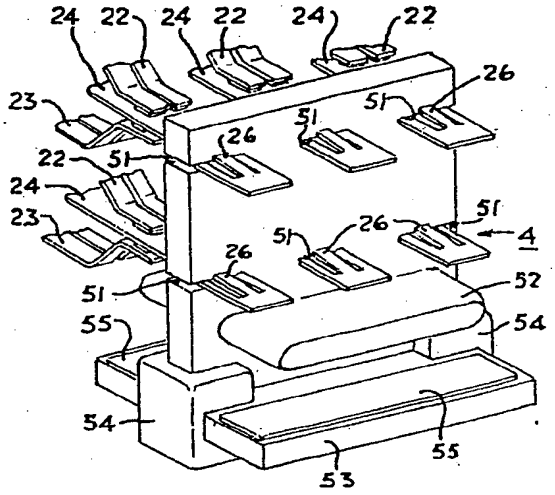


Fig. 2.

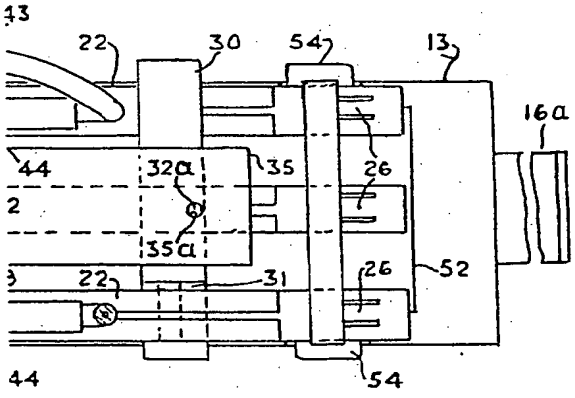
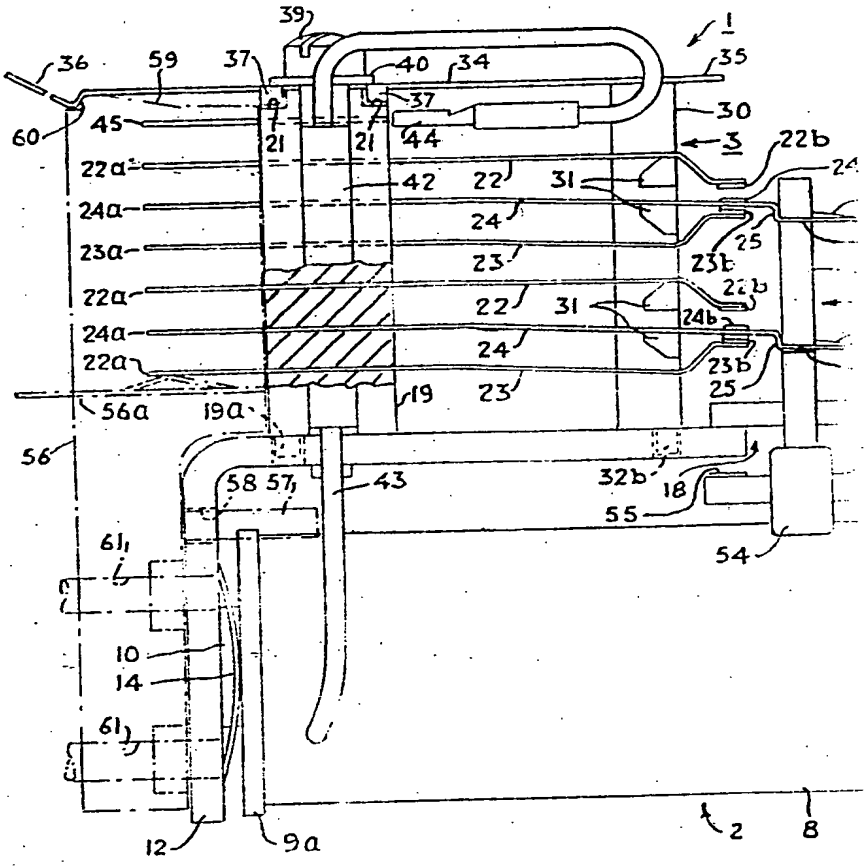


Fig. 3.



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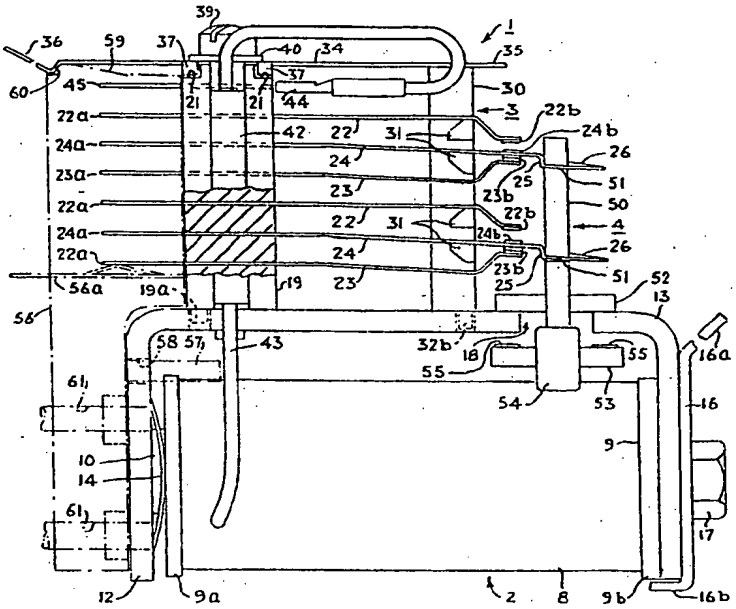

Fig. 1.

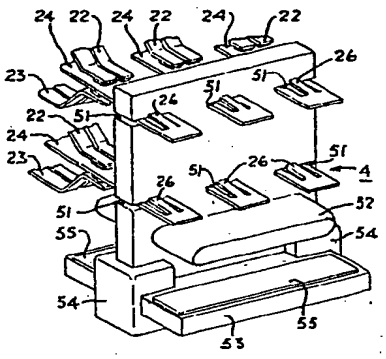

Fig. 2.

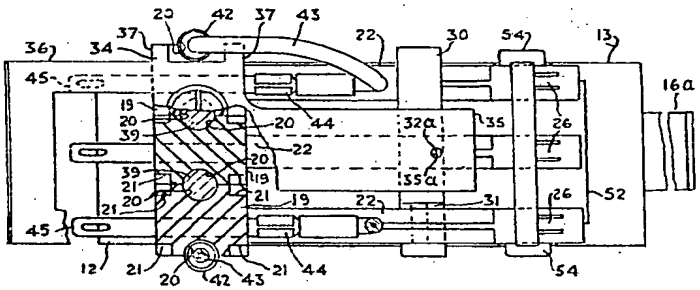

Fig. 3.

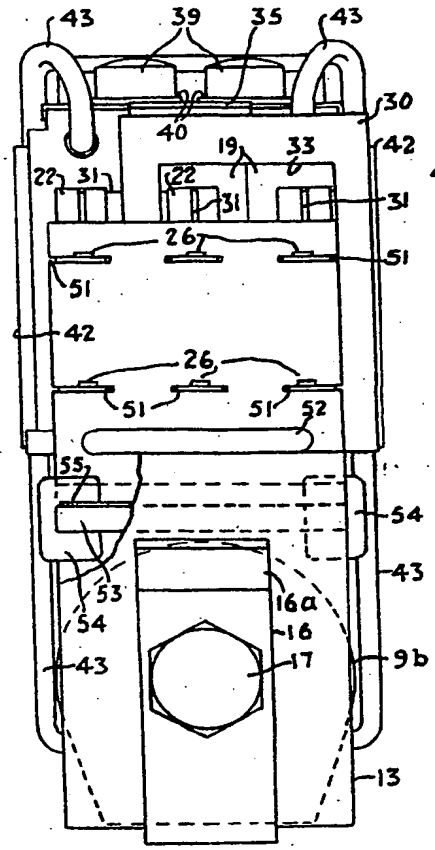

Fig. 4.

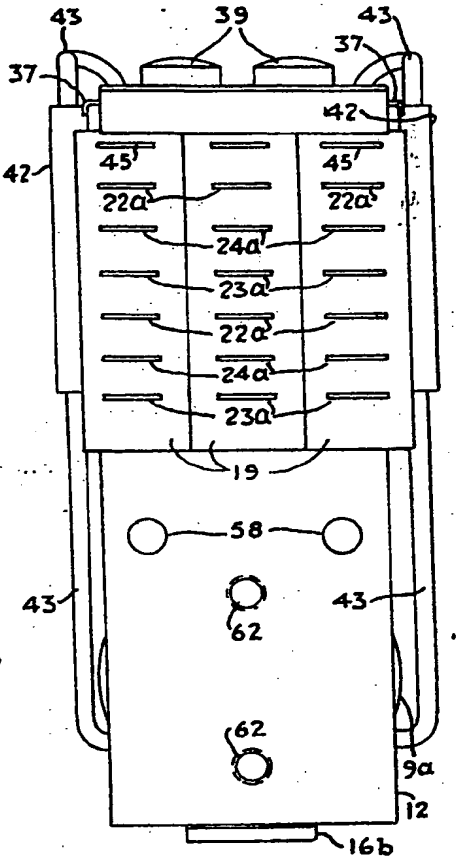

Fig. 5.